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短報 Short Note

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タコの生殖における代替戦略

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Sneaker Male in Octopus

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**Abstract:** The copulation of *Octopus cyanea* was observed in the underwater of Hachijo Island, Central Japan. Firstly, two males pursued a female, and smaller male retreated. Following the start of copulation of large male and female, smaller male started again to approach the mating pair mimicking a female. Three individuals became finally at the state of tranquillity, and reposed over two hours. This behavior of smaller male seems to be a “sneaking”, one of alternative reproductive strategies. This behavior seems to be established in association with territorial behavior in octopus.

**Keywords:** *Octopus cyanea*, sneaking, alternative strategy, mating behavior

“Sneaker male” is a recently advocated concept of the alternative male strategies on reproductive behavior in which a defeated or small male will make success in reproduction against the mating pair’s guard. Such a behavior has occasionally been reported for mating process in several fish species that undergo with external fertilization (e.g. Gross, 1984), but seldom for invertebrate animals. One of the authors fortunately succeeded to observe a behavior of “sneaker male” in mating *Octopus cyanea* in the shallow waters of Hachijo Island, south off Honshu, Japan.

**Materials and methods**

Observation is made at Nazumado, Hachijo Island, south off Honshu, Japan, 15-22 m in

deep, on 16 Nov. 1992.

The terminology of body pattern, structure and coloration in the description owe Roper and Hochberg (1988).

**Observation**

*Mating process:* Firstly, observation started at the time when two males pursued a female, showing the restraining-like rapid color change between two males. Following the smaller male retreating, a female exposed on the top of rock, radiated the arm, and showed the display stretching the arm crown, expanding the interbrachial membrane to cover the rock, and playing distinct color change to brilliant white as copulatory light uniform (Pl. 1 fig. 1).

Following the female display, larger male

succeeded to copulate, and then the female raised up her head as "lookout posture" exhibiting pale brown pattern on the dorsal head. Succeeded male inserted the hectocotylus into female's mantle cavity from the left side, and started the copulation. Body color of the female changed danken, and the mating pair become the state of repose. During the copulation, female posed the "lookout posture" without rising dorsal eye papillae, and the reactions of copulated pair grew dull against external stimulation (Pl. 1 fig. 2).

After one hour, the defeated and retreated smaller male was mimicking a female and started again to approach the mating pair from the opposite side of mating larger male which was also posing "lookout posture" (Pl. 1 fig. 2, left). Mating pair showed no reaction to the approaching smaller male. This male then extended the hectocotylized arm at the position of back to back, and succeeded to insert the hectocotylus to female's mantle cavity from the right mantle opening. In copulation of smaller male, the precedent copulating male showed no reaction at all. Three individuals became finally at the state of tranquillity, and reposed over two hours (Pl. 1 fig. 3).

**Body color pattern in copulating female:** In start of mating, body surface is smooth, and showed white stripes on dorsal mantle (Pl. 1 fig. 1, left). Only a few posterior dorsal mantle papillae were weakly raised. White stripe on the dorsal head was indistinct. White web darkened. After a little move, the almost of all papillae excluding the primary dorsal eye papillae, were raised (Pl. 1 fig. 2, right).

**Body color pattern in large male:** During the mating, all primary and secondary papillae rose. Brilliant white color of the "arm white spots" on the tip of primary papillae were distinct. All light chromatic components excluding light mantle bands were also distinct. A pair of primary dorsal eye papillae rose conspicuously (Pl. 1 fig. 1, right).

**Body color pattern in smaller male:** It was paler in brown than the large male. The distinct white spots of the flat primary papillae which were distinct in mating large male, were not so distinct in smaller male. Dorsal mantle white line and dorsal head white stripes were also indistinct. Light mantle band on the dorsal mantle was similar to those of female (Pl. 1 fig. 2, left; fig. 3 left).

## Discussion

The mating behavior of *Octopus cyanea* was reported in detail by Yarnall (1969) and Wells and Wells (1972). In the present observation, the first sexual display of male, "courtship stripe" described by Van Heukelem (1983) was not observed. During the female's "copulatory light uniform white" body pattern is only on arm crown, and the ocellus is not observed like Van Heukelem (1983) reported. The direction of hectocotylus insertion of the first male was the same as that described by Yarnall (1969).

On the female's "lookout posture" in the present observation, the skin is totally rugose, and the papillae were raised as the description of Roper and Hochberg (1988).

The attitude and skin coloration of defeated male seem to be mimic of female. Absence or presence of bright, white dorsal head stripes is distinct difference between normal male and female during copulation. The smaller male lacks these characteristic "stripes." This feature matches to the definition of "sneakers" (Turner, 1993). Sneaker male in the present observation was smaller than the rival male. In the Hachijo Island, the similar "double-males copulation" was frequently observed during the autumn and winter (Katoh, pers. comm.). In the field observation of octopus behavior, Tanaka (1955) also reported the example of a "double-males copulation" in *Octopus vulgaris*. Also in *O. bimaculatus*, the observation of six males attempting to mate a single female (Ambrose in Hanlon and Messenger, 1996). In squid, the existence of sneaker male was recently reported in *Loligo vulgaris reinaldii* (Hanlon & Messenger, 1996). Small male is mimicking female body color pattern in copulation.

In fish, the sneaker male is frequently observed in the species establishing the territory by male (Turner, 1993). Benthic octopus is an animal with a distinct territory for foraging around its den (Mather and O'Dor, 1991; Van Heukelem, 1983). Sneaking of octopus in reproductive strategy is thus considered to be established in association with territorial behavior.

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要旨：伊豆諸島八丈島において，ワモンダコ *Octopus cyanea* の雌1尾に対し，2尾の雄による交配行動が観察された。雌による交配を誘うディスプレイに対し，2匹の雄が反応し，そのうちの大きい個体が交配に成功した。交配開始しばらくの後，交配個体の反応が鈍くなると，大型の交配雄の雌を挟んだ反対側から小型の雄が接近し，同雌個体に交配を行った。小型の個体は，交配行動を行うに際し，体表突起状の白斑及び頭部外套膜状の白線状の斑紋を大型雄に比べ不顕著にし，雌に近い体色パターンをとった。これは，生殖行動における不利な雄の代替戦略のひとつであるスニーカーメール Sneaker male に該当する行動と考えられる。タコ類におけるスニッキング行動が実際に観察，記録されたのは今回がはじめてと考えられるが，八丈島のワモンダコ個体群においては，わりと観察される行動であるという。この代替戦略はタコ類が生殖に際して交配行動を行うこと，縄張りを有するという軟体動物においては高度な習性を持つことに起因すると考えられる。

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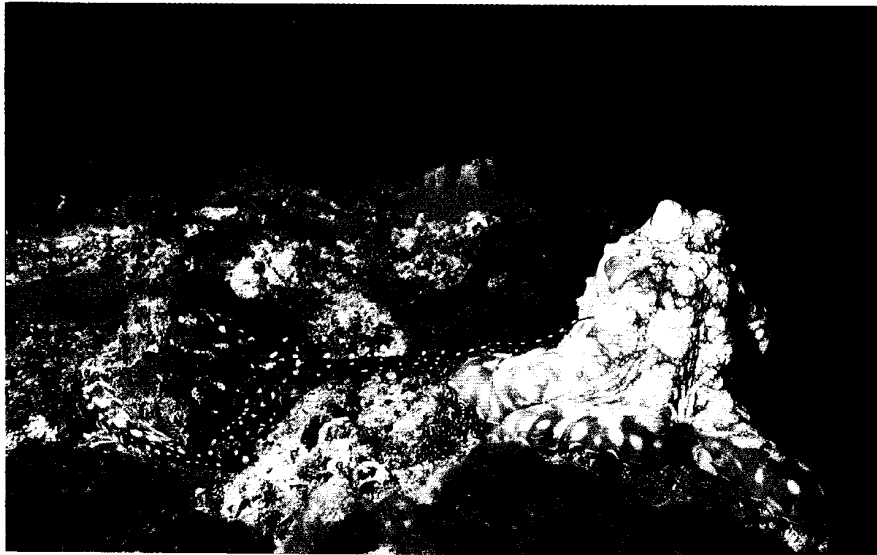
**Plate 1.**

1. Large male (right) mates female showing brilliant white body color pattern (left).
2. Mating sneaker male showing lookout posture (left) with female (right).
3. Two males attempting to mate with a female (center).

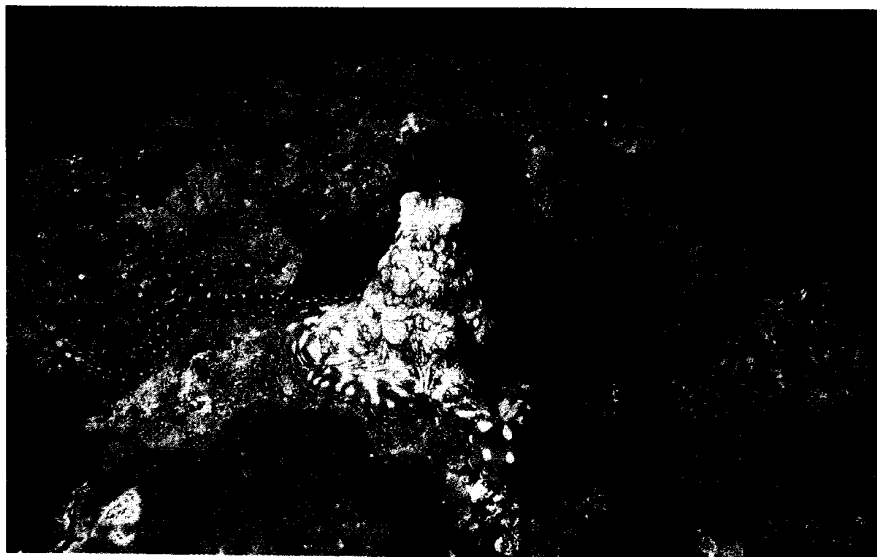
Plate 1



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